

## **REMARKS**

### **Status of Application**

Claims 1-10 are pending. The remaining claims have been withdrawn by the Examiner as directed to non-elected inventions. These claims have been cancelled without prejudice to their prosecution in other application(s).

### **Claim Rejections**

The Office Action states that claims 1-3 and 5-10 are rejected under 35 U.S.C. § 102 (b) as being anticipated by US Patent No. 4,874,739 by Boxhoorn, in view of US Patent No. 6,417,136 by Cheung, et al. Applicant understands this rejection to be a rejection under 35 U.S.C. § 103 instead of under § 102 (b): the Examiner first cited Section 103 (a), and the Examiner combined two references to arrive at the rejection. Applicant respectfully traverses this rejection.

With regard to claim 1, the Examiner characterizes Boxhoorn as teaching a process for the preparation of a silver-containing catalyst suitable for the oxidation of ethylene to ethylene oxide. According to the Examiner, Boxhoorn teaches a step of impregnating a preformed alpha-alumina carrier (citing claim 1 of Boxhoorn), which has been subjected to calcining, and optionally other preforming treatments, as part of the preforming process (citing claims 1 and column 2, lines 44-66 of Boxhoorn) with at least one alkali metal hydroxide modifier (citing claim 3 of Boxhoorn). Further, the Examiner finds that Boxhoorn teaches an optional step of drying the impregnated carrier (citing column 4, lines 16-20 of Boxhoorn). The Examiner agrees that Boxhoorn does not explicitly teach calcining subsequent to impregnation with the alkali metal salt.

The Examiner relies upon Cheung to fill the teaching that Boxhoorn lacks. Cheung is characterized as being drawn to a hydrocarbon hydrogenation catalyst and process of making [sic-the catalyst]. The Examiner cites Cheung as teaching calcining a metal-incorporated alumina to produce a carrier (claim 1) wherein the metal is incorporated by impregnation (claim 2), and that Cheung teaches that the

process can involve the following steps: impregnating the alumina carrier with palladium, drying, calcining, then impregnating with a catalyst component, drying and calcining (claim 65). Finally, the Examiner finds that Cheung teaches the addition of both silver and an alkali metal compound impregnated by an alkali metal hydroxide (col 6, lines 30-65).

The Examiner concludes that at the time of invention, it would have been obvious to a person of ordinary skill in the art to perform the process of Boxhoorn including the addition of a subsequent calcining step after impregnation with the alkali metal salt, in view of the teaching of Cheung. The Examiner finds the suggestion or motivation for doing so would have been to produce a carrier and catalyst having preferred and suitable physical features of surface area, pore volume, average pore diameter, and crystalline domain size, citing to Cheung at col. 14, lines 45-49.

Applicant respectfully submits that there is no motivation to combine the teachings of Boxhoorn and Cheung. First, as noted by the examiner, Cheung is directed to making and using a catalyst support and catalyst for the *hydrogenation* of "highly unsaturated hydrocarbons" such as an alkyne or a diolefin. Hydrogenation is a chemical reaction where, for example, a molecule such as oxygen is removed or a molecule such as hydrogen is added. The claims of the present invention are directed to a method of modifying a carrier for a catalyst to be used for the vapor phase *epoxidation* of ethylene and a method of preparation of a catalyst to be used for the vapor phase *epoxidation* of ethylene. Ethylene epoxidation is a reaction where olefins are combined with molecular oxygen. Thus, the chemical reactions occurring in Cheung and Boxhoorn are opposite in nature, not analogous. One of skill in the art of making improved carriers for ethylene oxide epoxidation catalysts would not look to art applicable to the hydrogenation of an alkyne or a diolefin.

Second, one of skill in the art would be deterred from combining the teachings of Cheung with Boxhoorn in that the preferred surface areas and average pore diameters of Cheung and Boxhoorn are significantly different. There is no indication that a calcination treatment which results in changed physical characteristics for Cheung would be desired or needed for the carrier of Boxhoorn, or that a carrier of

such different physical characteristics would be affected in the same manner as the carrier of Cheung. Cheung's most preferred surface areas are in the range of from 10 m<sup>2</sup>/g to 80 m<sup>2</sup>/g (col. 16, lines 32-38). In contrast, the preferred surface area in Boxhoorn is from 0.2 to 2 m<sup>2</sup>/g (col.3, lines 5-7). The average pore diameter of the metal aluminate catalyst support in Cheung is generally in the range of from about 50 angstroms to about 1000 angstroms, preferably in the range of from about 50 angstroms to about 750 angstroms, and most preferably, in the range of from 50 angstroms to 450 angstroms (col. 16, lines 3-8). The broadest range of 50 to 1000 angstroms is the equivalent of 0.005 to 0.1 microns. In Boxhoorn, Examples 1 and 2, the average pore diameter is 2.6 microns and 2.4 microns, respectively. Thus, the largest average pore diameter of the support in Cheung is a fraction of the average pore diameter of the support in Boxhoorn.

Third, according to the Examiner, the motivation for the combination of Boxhoorn and Cheung is the production of a carrier and catalyst having preferred and suitable physical features of surface area, pore volume, average pore diameter, and crystalline domain size, citing col 14, lines 45-49). One of skill in the art would not be motivated to combine Cheung's drying and high temperature calcining steps with Boxhoorn's alkali-impregnated alkali-metal enriched and tin-modified carrier. Boxhoorn's impregnation of an alkali metal compound prior to the impregnation of a silver compound is purely an optional and arguably less preferred embodiment of Boxhoorn's invention, demonstrating that the alkali metal-enriched and tin-modified alumina carrier must already possess "preferred and suitable physical features of surface area, pore volume, average pore diameter, and crystalline domain size". Thus, the Boxhoorn carrier does not require additional high-temperature calcining to achieve such properties.

Unlike Cheung, the present application teaches that:

While the present invention is not limited by any theories, it is believed that a possible explanation for the mechanism of the modifications described above is that the modifier(s) react with surfaces of the microscopic alumina particles contained in the calcined alumina, and as a result affect one or more properties, for example, roughness, degree of crystallinity, chemical composition etc., of the surfaces of the microscopic

alumina particles, *without substantially altering the morphology, pore volume and/or pore size distribution, and in some cases surface area, of the calcined alumina.* As a result of this mechanism, it is believed, *any of the modifications according to the present invention can be performed on alumina which has already been calcined, and which may preferably already have desirable morphology, surface area, pore volume and/or pore size distribution,* to modify the surfaces of the calcined alumina in a way which provides improved efficiency, activity and/or stability. It is a further feature of the present invention that the calcined alumina may be a material which could be employed as a carrier as is, that is, without modification according to the present invention.

(page 4, lines 1-13)(emphasis added)

And that:

As described above, the modification according to the present invention can be conducted in such a way that properties of the surfaces of the microscopic alumina particles can be affected *without substantially altering the morphology, surface area, pore volume, pore size distribution and/or bulk density of the calcined alumina.* As a result, where preformed alumina having shape, morphology, surface area, pore volume, pore size distribution and bulk density which are desirable for a carrier is modified in accordance with the present invention, the resulting shape, morphology, surface area, pore volume, pore size distribution and bulk density of the modified alumina carrier are likewise desirable for a carrier. Accordingly, the preformed alumina preferably has shape, morphology, surface area, pore volume, pore size distribution and bulk density shape which are desirable for alumina carrier.

(page 5 lines 11-21)(emphasis added)

According to teachings of the present application, one of skill in the art begins with a calcined alumina that is *already* suitable for use as a carrier as is. Then, a desirable chemical modification is made to further improve catalyst performance without substantially altering the physical properties of the support. There is nothing in the teachings of Boxhoorn, Cheung, or the combination of Boxhoorn and Cheung to suggest the claimed invention.

With regard to claim 2, the Examiner finds that both Boxhoorn and Cheung teach a step of depositing silver catalytic material on the calcined carrier. However, taking the teachings of Cheung as a whole, Cheung's catalyst compositions comprise palladium in addition to silver. This difference between Boxhoorn and Cheung

further suggests that one of skill in the art would not expect Cheung's teachings to be applicable to ethylene epoxidation catalysts and their supports.

With respect to claim 3, the Examiner relies upon claims 11 and 12 of Boxhoorn, finding that Boxhoorn carries out calcining at a temperature of 1200 to 1700°C. The Examiner indicates that it would be obvious for both calcining steps to occur within the same temperature ranges, as calcining happens at a set range. Thus, the same temperatures would be used for each calcining step. Applicant, however, notes that there is no teaching in Boxhoorn that a calcination step is desired or necessary after the impregnation of the carrier with one or more dissolved alkali metal compounds which will act as a promoter.

The Examiner maintains that Boxhoorn teaches a method wherein the alpha – alumina carrier is prepared by contacting boehmite alumina and/or gamma-alumina with an acidic mixture containing halide anions and water (citing claim 2 and column 1, line 54-column 2, line 2 of Boxhoorn). Boxhoorn does not state that the boehmite alumina and/or gamma alumina is contacted *with an acidic mixture* containing halide anions and water. Rather, Boxhoorn discloses several compounds, one of which is an alkali metal fluoride salt, which can be added to the boehmite alumina and/or gamma alumina.

Additionally, claims 5 through 9 are dependent directly or indirectly upon claim 1 or 2. Given that claims 1 and 2 are patentable, claims 6 through 9 are as well. Further, Boxhoorn teaches the use of an alkali metal compound as either an additive to the carrier precursor or as a catalyst promoter. Boxhoorn does not teach the use of an alkali metal hydroxide added as a modifier added to a preformed carrier, where the modified carrier is then subjected to calcination.

The Examiner relies on Cheung to reject claim 10. For the reasons set forth above, one of skill in the art would not look to the teachings of Cheung for application to supports for ethylene epoxidation catalysts.

Claim 4 is rejected under 35 U.S.C. § 103 (a) as being unpatentable over US Patent No. 4,874,739 by Boxhoorn in view of US Patent No. 6,417,136 by Cheung et al, as applied to claim 1 or 2 above, in view of US Patent No. 4,994,589 by Notermann. Applicants respectfully traverse this rejection. Claim 4 is dependent on claim 1 or 2. Given that claims 1 and 2 are patentable, claim 4 is as well.

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Applicants respectfully requests consideration of the rejection of claims 1-10 and further submit that claims 1-10 are in condition for allowance.

Respectfully submitted,

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